

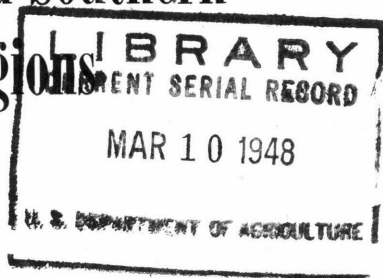
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# TREE PLANTING

in the  
Central, Piedmont, and Southern  
Appalachian Regions



Farmers' Bulletin No. 1994  
U. S. DEPARTMENT OF AGRICULTURE



**Y**OUR farm woodland is an essential part of a good farm business. With a little intelligent care it can be made to yield an income, plus wood for farm and home use. Trees should be regarded as a crop and grown and harvested with a thought to the greatest value of products year after year. In addition to the existing woodland on almost every farm there is some land that will return the owner greater profit from growing trees than from any other crop or use, and with much less labor and trouble. These areas of your farm should be picked out and planted to the proper tree species. It is a part of good land use.

The purpose of this bulletin is to help you learn what lands should be planted to trees, what trees to plant, how to plant them, and how to care for your tree crops so they will produce income for you, your children, and grandchildren.

For the regions covered here, this publication supersedes Farmers' Bulletins 1123 and 1453, Growing and Planting Hardwood Seedlings on the Farm, and Growing and Planting Conifers on the Farm.

Washington, D. C.

February 1948

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COVER PHOTO.—One-year-old shortleaf pine seedling being planted on an abandoned field

III





# TREE PLANTING IN THE CENTRAL, PIEDMONT, AND SOUTHERN APPALACHIAN REGIONS

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## TREE PLANTING IS FARMING

Trees are a farm crop the same as corn and cotton. If given reasonable care and attention they will return cash income and usable products to the farmer. In the past, most farm woodlands and areas unprofitable for field crops were not managed as a part of the farm business, and the owners lost most of the income possible from such lands. The purpose of this bulletin is to point out how rough, abandoned portions of the farm, unsuitable for cultivated crops or good pasture, can be turned to profitable use by planting tree crops. Improving poor or understocked woods by planting additional trees is also discussed.

The farmers of America are in the tree-growing business. Forty percent of all privately owned forest land is owned by farmers—almost 3½ million of them. In the regions covered by this bulletin (fig. 1),

almost half of all farmer-owned land is woods. This does not include cleared, cultivated, or pastured land that is better suited to tree growing.

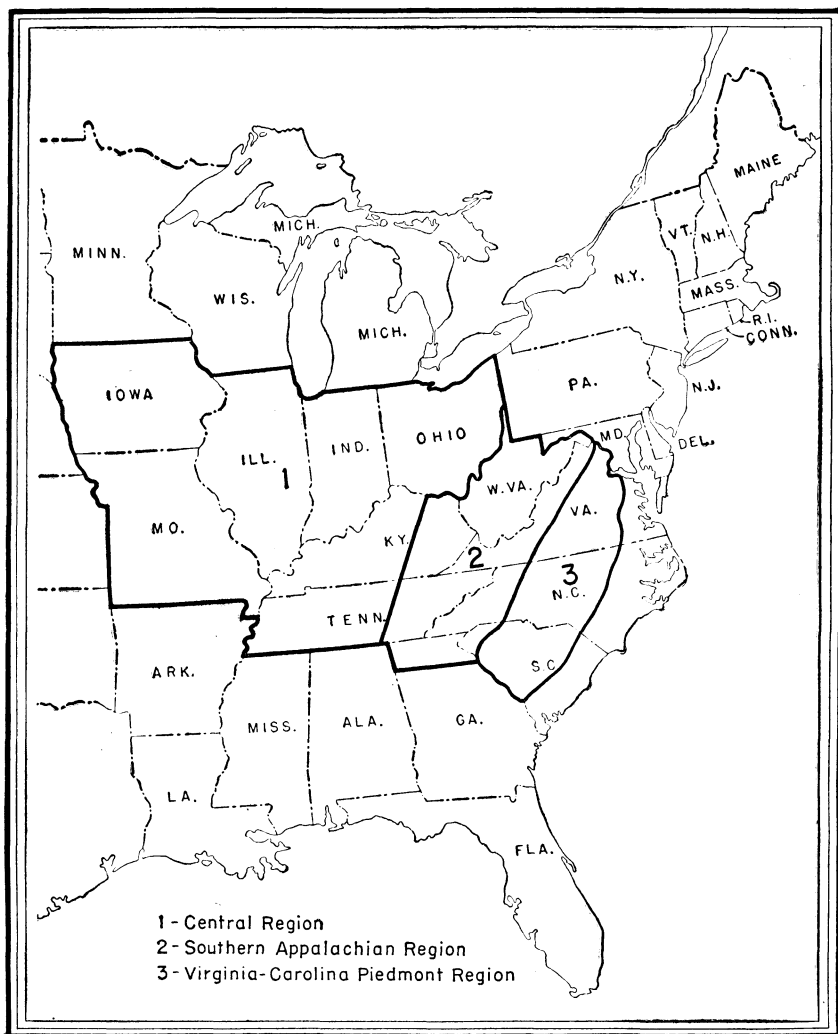


FIGURE 1.—Location and boundaries of the three regions covered in this bulletin.

The idea of wise land use is important. The best farmer manages his farm in such a way that each portion does its best work. The way the land is used should depend on its natural capability. The greatest income will be obtained when the crops grown and the management system used are best suited to the character of the land. You don't plant your garden on the poorest land you have, but select a good spot for it. So also you should select the land best suited for each of your other crops, including the forest crop.

## WOOD IS MONEY

Yes, wood is money or can be turned into money the same as tobacco or corn. Wood products may be sold for cash or used on the farm. Too often the farmer forgets how much cash it would cost if he had to buy such wood products as posts, fuel wood for heating and cooking, or for curing tobacco.

Under good management the farm woodland can provide an income each year for generations, and at the same time protect and improve the soil, prevent erosion and floods, beautify the landscape, and shelter birds and other wildlife. For all these returns it requires little toil. It does not hold the farmer to a set schedule of work like field crops. Improvement work or harvesting can be done at odd times or slack seasons. It will return extra money for extra labor during the winter, almost like going to the bank and drawing your interest. If the market is poor, postpone your main harvest until it is better. This crop will keep, and at the same time continue to increase in amount and value.

## GROWTH AND YIELD FROM PLANTATIONS

Many farmers hesitate to plant forest trees because they think it takes so many years to get any returns that they will receive nothing for their work within their lifetime. Figure 2 shows a promising plantation of shortleaf pine, almost ready for some thinning, which grew from seedlings in the brief space of 6 years.

The approximate growth of the trees recommended for planting is given in table 1. The values are for the average of the site quality (type of land, including its location, and soil) recommended in the planting guides on pages 13, 14, and 16. Actual growth will vary considerably from that shown in table 1, depending on the site, and the weather and climate. A dry year will hold back tree growth on any soil. In the southern part of the region trees will grow faster than in the northern part. The figures in table 1 are average for the stand. Some trees will be much larger than this and some smaller.

On very good sites the fastest growing species are black locust and yellow-poplar. Cottonwood will grow very rapidly on deep, moist soils. The pines, especially loblolly and shortleaf in their range, will grow well on medium and poor sites. Eastern white pine will grow rapidly on medium to good sites. Walnut, oak, ash, cedar, and spruce will usually grow more slowly. Ordinarily the pines and cedar would be planted on the poorer planting sites because they will grow and succeed where the hardwoods will not. In comparing growth figures of different species in table 1, remember that the hardwoods are assumed to be on much better sites than the pines.

The chief forest products obtained from the different species and the approximate yield on the average of the sites recommended for planting are given in tables 2 and 3. Accurate values for a particular site are impossible to give in a general bulletin and the figures in the tables only suggest what may be expected under average conditions from

plantings on correct sites, adequately protected from fire and grazing, and with good survival of about 1,000 trees per acre. Yields will often be much greater than those shown in tables 2 and 3. This is especially true in the case of Christmas trees. Where a market is assured for pine and cedar Christmas trees they can be planted with a much closer spacing, say 4 by 4 feet and thinned at about the ages indicated in table 2. In this way early yields from Christmas-tree thinnings can be increased by several times the number shown in table 2.



FIGURE 2.—Shortleaf pine on an abandoned field 6 years after planting. The soil is poor but the pine has made a good start. In a few more years thinnings from this plantation can be marketed or used on the farm.

TABLE 1.—Approximate average height and diameter of trees at 10-year intervals on the average planting sites recommended for the species

Species	Height and diameter breast high after—											
	10 years		20 years		30 years		40 years		50 years		60 years	
	Height	Diam-eter	Height	Diam-eter	Height	Diam-eter	Height	Diam-eter	Height	Diam-eter	Height	Diam-eter
Conifers:	Feet	Inches	Feet	Inches	Feet	Inches	Feet	Inches	Feet	Inches	Feet	Inches
Loblolly pine	16	2.5	34	4.3	49	7.0	59	9.5	67	12.0	75	13.5
Shortleaf pine	14	1.8	26	3.3	38	5.5	49	8.0	57	10.5	68	13.5
Eastern white pine	12	1.5	24	3.0	38	5.0	50	7.5	58	10.0	70	13.5
Red pine	7	1.5	21	3.0	36	5.0	50	7.0	58	9.0	70	12.0
Jack pine	12	1.5	27	4.0	40	6.0	52	7.0	60	8.0	66	9.5
Pitch pine	10	1.0	20	2.5	30	4.5	38	6.5	46	8.0	54	9.0
Virginia pine	14	1.8	26	3.5	38	5.5	48	7.5	52	9.0	60	10.0
Redcedar	8	1.5	18	3.0	26	5.0	33	6.5	38	8.0	43	9.5
Hardwoods:												
Yellow-poplar	28	3.0	47	5.8	58	7.5	65	10.0	70	12.0	80	17.0
Black locust	26	2.5	38	4.5	48	6.0	60	7.0				
White ash	12	1.0	28	2.5	42	4.0	50	6.0	58	7.5	64	9.0
Black walnut	12	1.5	26	3.5	40	5.5	50	7.5	56	9.0	60	10.0
Northern red oak	10	1.0	24	2.5	40	4.0	50	6.0	58	7.5	64	9.0
Cottonwood	30	5.0	50	9.0	65	13.0	72	17.0				
Sycamore	25	5.0	45	8.0	60	10.0	65	14.0				

In tables 2 and 3 no attempt is made to include the many minor forest products, many of which will be used on the farm. Prices are omitted because they vary so much in different localities and from year to year. The extension forester or State forester can advise on prices and demand for certain products.

### PROFIT FROM PLANTING TREES

Tree plantations successfully established on the right lands and protected from destruction by fire or grazing will almost surely return a profit to the owner. The amount of profit depends on a great many things, but chiefly on prices at the time of harvest, and the quality of the site (which affects the amount and quality of the wood products). Some special products, like posts or Christmas trees, may pay better than field crops on small areas of good land. Most tree growing, however, is done on land unsuited to pasture or cultivation. On such "waste" land profit from tree plantations is clear gain.

You may have heard of very high returns from tree plantations on excellent sites. These are not average, however. The figures in tables 2 and 3 are average and moderate. With the help of the tables you can get some idea of the profit you are likely to get from your trees. If you wish to increase your total net income from the trees, you should do the planting, improvement work, and harvesting yourself. In this way you can earn the wages you would otherwise give to someone else. Much of the work can be done when other farm work is slack.

The chief costs of establishing and maintaining trees are for buying the young trees, planting, and protection from fire and livestock. Land is generally available and improvement cuttings and thinnings usually pay for themselves. In a strict sense interest on the investment is a cost, but early cuttings of posts, pulpwood, and other products more than cancel any interest charges.

An example of cash returns per acre from loblolly pine, based on the figures in table 2, shows a gross return of \$4.78 per acre per year for 70 years. The stumpage prices (prices paid for standing trees) used in figuring are \$1.50 per cord for pulpwood, \$2.50 each for poles, and \$12 a thousand board feet for saw timber. A survival of at least 1,000 trees per acre is assumed. The cash cost per acre to the farmer, assuming he already owned the land, would be about as follows:

Cost of planting stock.....	\$2. 50
Cost of planting (labor hired).....	6. 00
Cost of protection and taxes at 10 cents per acre per year for 70 years.....	7. 00
<b>Total cost per acre.....</b>	<b>15. 50</b>
<b>Total cost per acre per year.....</b>	<b>. 22</b>
<b>Net return per acre per year.....</b>	<b>4. 56</b>

Many other examples could be worked out in the same way. Your costs may be higher than those in the example but your returns may also be higher. In one instance a small Christmas tree plantation in Ohio, where all labor was hired, gave a net income of \$142.05 per acre in 16 years. This equals \$8.88 per acre per year after all investment costs were paid, or a 7.8 percent yield on the investment.

TABLE 2.—*Yields of conifers on the planting sites recommended, and their chief uses*

Species and chief uses <sup>1</sup>	Approximate number of years required to produce <sup>2</sup>			Approximate yield per acre <sup>3</sup>		
	1st cut	2d cut	3d cut	1st cut	2d cut	3d cut
Loblolly pine:						
Pulpwood.....	20	30	70	5 cords.....	20 cords.....	5 cords.
Poles and piling.....	40	---	---	20 pieces.....	---	---
Logs.....	70	---	---	20 M bd. ft.....	---	---
Shortleaf pine:						
Pulpwood or mine props.....	25	35	70	3 cords.....	18 cords.....	4 cords.
Poles and piling.....	40	---	---	15 pieces.....	---	---
Logs.....	70	---	---	15 M bd. ft.....	---	---
Eastern white pine:						
Pulpwood.....	25	35	70	3 cords.....	18 cords.....	5 cords.
Logs.....	70	---	---	18 M bd. ft.....	---	---
Red pine:						
Christmas trees.....	7	8	9	100 trees.....	50 trees.....	50 trees.
Pulpwood or mine props.....	25	35	80	3 cords.....	15 cords.....	5 cords.
Logs.....	80	---	---	18 M bd. ft.....	---	---
Jack pine:						
Christmas trees.....	5	6	7	100 trees.....	50 trees.....	50 trees.
Pulpwood or mine props.....	25	35	50	5 cords.....	20 cords.....	30 cords.
Pitch pine, pulpwood or mine props.....	25	35	50	3 cords.....	15 cords.....	20 cords.
Virginia pine:						
Christmas trees.....	5	6	7	100 trees.....	50 trees.....	50 trees.
Pulpwood or mine props.....	20	30	40	5 cords.....	15 cords.....	20 cords.
Redcedar:						
Christmas trees.....	8	10	12	100 trees.....	50 trees.....	50 trees.
Posts.....	30	40	50	150 posts.....	250 posts.....	350 posts.
Logs.....	50	---	---	7 M bd. ft.....	---	---
Norway spruce, <sup>4</sup> Christmas trees.....	8	10	12	600 trees.....	600 trees.....	600 trees.

<sup>1</sup> All species may be used for fuel wood or tobacco wood. Wood to be used for burning should be material obtained from thinnings or improvement cuttings and not suitable for other purposes. If treated with a preservative, any of the pines make good fence posts. Pine ties may sometimes also be sold.

<sup>2</sup> In intensive woodland management several additional cuts would be made between the second and third cuts, as shown here.

<sup>3</sup> This does not include small products such as fuel wood, stakes, etc. A survival of 80 percent of the trees is assumed. Spacing is 6 by 6 feet, except Norway spruce, as noted in footnote 4.

<sup>4</sup> Recommended only for Christmas trees. The trees must be planted 4 by 4 feet apart and all used, except the culls, to get the yields shown in the table.



TABLE 3.—*Yields of hardwoods on the planting sites recommended, and their chief uses*

Species and chief uses <sup>1</sup>	Approximate number of years required to produce <sup>2</sup>			Approximate yield per acre <sup>3</sup>		
	1st cut	2d cut	3d cut	1st cut	2d cut	3d cut
Yellow-poplar:						
Pulpwood or mine props	20	30	70	7 cords	25 cords	7 cords.
Logs	70			25 M bd. ft.		
Black locust:						
Posts	15	20	<sup>4</sup> 25	150 posts	400 posts	600 posts.
White ash:						
Logs	50	70		10 M bd. ft.	15 M bd. ft.	
Black walnut:						
Logs	60	80		3 M bd. ft.	10 M bd. ft.	
Northern red oak:						
Pulpwood, mine props, acid wood, and ties	40	80		18 cords	3 cords	
Logs	80			10 M bd. ft.		
Cottonwood:						
Pulpwood	15	20	25	5 cords	20 cords	20 cords.
Logs	40			20 M bd. ft.		
Sycamore:						
Pulpwood or mine props	20	30	70	7 cords	25 cords	7 cords.
Logs	70			25 M bd. ft.		

<sup>1</sup> All species may be used for fuel wood. Wood to be used for burning should be material obtained from thinnings or improvement cuttings and not suitable for other purposes. If treated with a preservative, yellow-poplar and cottonwood make good posts.

<sup>2</sup> In intensive woodland management cuts would be more frequent than shown here.

<sup>3</sup> This does not include small products such as fuel wood, stakes, etc. A survival of 80 percent of the trees is assumed. Spacing is 6 by 6 feet.

<sup>4</sup> A better plan would be to cut some posts each year as needed.

It should be remembered that early returns can be obtained from cutting small products not listed in tables 2 and 3. It is not necessary to wait for sawlogs. What products are sold will depend partly on demand.

### WHAT LANDS TO PLANT

What parts of his farm should a man consider for tree planting? It is not the purpose of this bulletin to "sell" tree planting where other farm practices will yield greater returns. Rather, we want to help the farmer select the areas where tree plantations will return more benefit than other uses and tell him how to establish and take care of his trees.



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FIGURE 3.—Old abandoned field with adequate natural tree reproduction. This field does not need to be planted.

Tree planting should usually *not* be done on nonerosive level land fertile enough for profitable crop production, or if the land is suitable for a successful permanent pasture, either natural or improved. If the land is reseeding naturally and fully to profitable tree species in a reasonable time, planting is unnecessary. Areas that have 600 to 700 desirable and well-distributed natural seedlings per acre are reseeding successfully. Careful examination of the land will tell whether desirable natural reseeding is taking place (fig. 3).

Slopes from which the water runs off quickly should be planted to trees to halt erosion of the soil, and prevent flooding and silting of lower lands (fig. 4).



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FIGURE 4.—Example of land much of which is too steep for continuous cultivation. The best of the slopes could be converted to improved pasture. The steepest and poorest should be reforested.

Certain exceptions should be noted. If you have need for forest products not available elsewhere on your farm, you should plant trees on some of the land suitable for pasture or crops. In a balanced farm business, a well-stocked farm woods is usually a necessity. Poles and posts are often needed and you can probably raise them more cheaply than you can buy them.

Any unused corners or plots of land, suitable for pasture or crops but too small in size, could well be planted to trees. Planting for shelter belts around farm buildings or fields, and small plantings for recreation purposes (such as picnic grounds) could be justified even on good agricultural land.

## HOW TO SELECT SPECIES FOR PLANTING SITES

Now that the areas for planting have been chosen, what species of trees shall be planted? This proper matching of species to planting sites, or planting the right tree in the right place, is the heart of success with trees. If the correct species is chosen it will have good chances of success, and if properly handled and cut it will reproduce itself, together with other naturally occurring species, generation after generation.

You do not have to be a forester or a soils expert to make the right selection. Forest experiment stations have made trials with different species on different soils so they can give you the benefit of their studies. The following sections will explain in a simple way how to



select the right tree or trees for your land. If you have a State extension forester, or a State forester he may be able to give you on-the-spot advice.

### WHAT TREES NEED

Trees are plants the same as corn or grass. They need soil, sun, moisture, and some fertility. Some kinds have very much higher requirements than others and they should be planted accordingly. Almost any area, no matter how bad or how good, can be successfully planted if the correct species of good-quality planting stock is used, the planting properly done, and the resulting plantations given needed care and protection. The key to success is the selection of the right species for a given piece of land. The growth rate and yield of trees depend on the quality of the soil and the weather and climate, the same as crops. It is wrong to expect all kinds of trees to make good growth on the most worn-out and eroded hillside field (fig. 5).

While trees have the same basic requirements as field crops (soil, air, water, and sunlight), fortunately there are some real differences in their ability to use land. Trees, especially the hardwood (broadleaf) trees, grow best in a deep, rather loose soil, with plenty of room for development of large root systems. Trees require much water and thrive best on soils loose and deep enough to enable the roots to develop. The soil should absorb water readily and not lose it too quickly. The physical structure or tilth of the soil, including the subsoil, is more important than the amount of mineral elements. Hardwood trees,



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FIGURE 5.—Six-year-old plantation on shallow topsoil, very compact subsoil. Shortleaf pine in background has done well; northern red oak and black walnut in foreground have failed. This is a pine or redcedar site.



FIGURE 6.—Neither ash nor black locust succeeded on this old-field site with a thin topsoil and hard, compact subsoil, although the soil is fairly fertile, as is shown by the growth of the grasses. The shortleaf pine in the background has been planted 7 years. The foreground was planted to white ash at the same time. The gaps in the pine stand were planted to black locust.

however, do not grow well on poor sandy soil, although it is loose and deep, as in sand-dune areas. The pines are much less affected. Agricultural crops have smaller root systems and, aided by cultivation and fertilization, will succeed on fields with dense, compact subsoil, where hardwood trees would fail (fig. 6). On the other hand, trees can grow on steep, rough, rocky land, where farm crops cannot. Each piece of land has its best use.

### PLANTING GUIDES

Three planting guides have been prepared, one for each region covered by this bulletin; that is, the Central States, southern Appalachian, and the Virginia-Carolina Piedmont regions. The purpose of these planting guides is to help you select the correct species for your particular planting area. There may be a choice of several. Two or more species often may be mixed to good advantage.

The three guides, together with the information in the previous section, *Wood Is Money*, and your personal preferences should enable you to reach a sound decision regarding species to plant. Remember that the most profit comes from the best land use and the best land use is obtained when the kind of crop is suited to the kind of land.

## CENTRAL STATES REGION

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Yellow-poplar, black walnut, northern red oak, black locust, white ash.	<ol style="list-style-type: none"> <li>1. North and east slopes, lower to middle south and west slopes, coves, and well-drained bottoms. Except for locust, very steep south slopes should be avoided. Locust will tolerate exposed sites if soil conditions are favorable.</li> <li>2. No apparent erosion; on abandoned fields top layer of dark-colored soil (topsoil) at least 6 inches deep; on unplowed areas layer of dark-colored topsoil at least 3 inches deep.</li> <li>3. Topsoil and at least 12 inches of soil layer beneath loose and friable, or mellow when worked; does not become hard and cloddy; drainage good.</li> <li>4. Light to moderate cover of weeds, briars, or shrubs desirable. Dense cover is more harmful to black walnut and black locust than to the other species. An open black locust stand is good cover for walnut and red oak. Avoid heavy sod but broomsedge is not detrimental except that, in broomsedge areas, rodent damage to seeded oak or walnut will usually cause failures.</li> </ol>
Sycamore, cottonwood.	<p><i>These hardwoods will not grow on dry, exposed slopes and ridges, and abandoned old fields with a shallow topsoil and heavy compact under layer. Black locust is suitable for deep gully control but should be planted only in gully bottoms where soils are light or where loose soil has accumulated.</i></p> <ol style="list-style-type: none"> <li>1. Well-watered bottom land, terraces, and upland flats.</li> <li>2. No erosion; on abandoned fields, top layer of dark-colored soil (topsoil) at least 6 inches deep; on unplowed areas layer of dark-colored topsoil at least 3 inches deep.</li> <li>3. Topsoil and at least 6 inches of soil layer beneath loose and friable; does not become hard and cloddy; drainage fair. Deep, sandy loams are best for cottonwood, but sycamore will tolerate a somewhat heavier soil.</li> <li>4. Dense or overtopping vegetation a definite hindrance; avoid heavy sod and herbaceous vegetation or break it up by cultivation.</li> </ol>
Eastern white pine----	<p><i>These species will not succeed on dry upland sites or eroded, worn-out old fields.</i></p> <ol style="list-style-type: none"> <li>1. North and east slopes, lower to middle south and west slopes, broad ridge tops or all slopes of low hills. Avoid very steep south slopes and wet upland flats or bottoms.</li> <li>2. Moderate erosion allowable; on abandoned fields top layer of dark-colored soil (topsoil) at least 4 inches deep; on unplowed areas dark layer desirable but not necessary.</li> <li>3. Topsoil loose and friable, or mellow when worked; layer beneath may be plastic or moderately compact but not dense and cloddy; avoid heavy clays; drainage should be fair to good.</li> <li>4. Light, open cover beneficial; broomsedge cover, moderate weed cover, or scattered low brush satisfactory; avoid tall, dense briars or brush and heavy sod.</li> </ol> <p><i>Eastern white pine will not succeed on badly eroded old fields with a very shallow topsoil and a dense, heavy clay under layer.</i></p>

## CENTRAL STATES REGION—Continued

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Norway spruce, red pine.	<ol style="list-style-type: none"> <li>1. North and east slopes, lower to middle south and west slopes, broad ridge tops, or all slopes of low or rolling land. Avoid wet upland flats and bottom lands. Confine planting to the northern third of the Corn Belt.</li> <li>2. Moderate erosion allowable; on abandoned fields top layer of dark-colored soil (topsoil) at least 4 inches deep; on unplowed areas dark layer 3 inches or more for Norway spruce and desirable but not necessary for red pine.</li> <li>3. Topsoil loose and friable, or mellow when worked; layer beneath may be moderately compact and cloddy when worked. The red pine will tolerate heavier soils than spruce. Drainage may be poor to good.</li> <li>4. Light, open cover desirable for red pine and moderate cover for spruce; avoid heavy, overtopping vegetation for red pine plantings. Spruce will stand considerable shade.</li> </ol>
Shortleaf pine, pitch pine.	<ol style="list-style-type: none"> <li>1. All slopes and ridges; avoid wet upland flats and stream bottom lands. Limit planting to southern half of the region.</li> <li>2. Severe erosion allowable; top layer of dark-colored soil (topsoil) may be absent or mixed with lower layer of reddish soil.</li> <li>3. No special soil conditions needed. Soil may be loose, or compact and cloddy, but the more friable, loose soils are better sites.</li> <li>4. Dense and overtopping vegetation causes heavy losses among seedlings. Broomsedge, light to moderate weed cover, or bare areas satisfactory.</li> </ol>
Jack pine-----	<ol style="list-style-type: none"> <li>1. All slopes and ridges; avoid wet flats or bottom lands. Limit planting to the northern third of the Corn Belt.</li> <li>2. Jack pine is especially suited to sandy areas with good drainage—8 inches or more of loose, sandy soil that crumbles easily when worked, and that does not become hard and cloddy.</li> <li>3. A light cover of vegetation is beneficial but heavy sod or overtopping cover should be avoided.</li> </ol>

## SOUTHERN APPALACHIAN REGION

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Black walnut-----	<ol style="list-style-type: none"> <li>1. Lower slopes, coves, well-drained bottoms, and sink-holes.</li> <li>2. No apparent erosion; top layer of dark-colored soil (topsoil) 8 inches or more deep.</li> <li>3. Topsoil and at least 16 inches of soil layer beneath loose and friable, or mellow when worked; does not become hard and cloddy; drainage good.</li> <li>4. Light to moderate cover of vegetation desirable; moderately heavy cover usually not harmful; cover of rank weeds, blackberry, or sassafras and blackberry indicates good sites; avoid heavy sod and broomsedge.</li> </ol>

## SOUTHERN APPALACHIAN REGION—Continued

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Black Walnut—Con.	<i>Walnut will not grow in swampy spot, or on dry, exposed slopes and ridges, and abandoned old fields with a shallow topsoil and heavy, compact under layer.</i>
Yellow-poplar, black locust, white ash.	<ol style="list-style-type: none"> <li>1. North and east slopes, lower to middle south and west slopes, coves, well-drained bottoms, and sinkholes. Except for locust, very steep southerly slopes should be avoided. Locust will tolerate exposed sites if soil conditions are favorable.</li> <li>2. No apparent erosion; top layer of dark-colored soil (topsoil) 6 inches or more deep.</li> <li>3. Topsoil and at least 12 inches of soil layer beneath loose and friable, or mellow when worked; does not become hard and cloddy; drainage good.</li> <li>4. Moderate to heavy cover of briars, tall weeds, and brush (sassafras, etc.) beneficial for yellow-poplar and white ash. Light, open cover beneficial for black locust. Dense, rank briars and weeds indicate good sites; avoid heavy sod and broomsedge without briars or some brush.</li> </ol> <p><i>These hardwoods will not grow on dry exposed slopes and ridges and abandoned old fields with a shallow topsoil and heavy, compact under layer.</i> Black locust is suitable for deep gully control but should be planted only on gully bottoms where soils are light or where loose soil has accumulated.</p>
Eastern white pine----	<ol style="list-style-type: none"> <li>1. North and east slopes, lower to middle south and west slopes, broad ridge tops or upper slopes of low hills. Avoid very steep southerly slopes.</li> <li>2. Moderate erosion allowable; top layer of dark-colored soil (topsoil) 5 inches or more deep.</li> <li>3. Topsoil loose and friable, or mellow when worked; layer beneath may be plastic or moderately compact but not dense and cloddy. Avoid heavy pure clays; drainage should be fair to good.</li> <li>4. Light, open cover beneficial; broomsedge cover, moderate weed cover, or scattered low brush satisfactory. Avoid tall, dense briars or brush.</li> </ol> <p><i>Eastern white pine will not succeed on badly eroded old fields with a very shallow topsoil and a dense, heavy clay under layer.</i> At elevations over about 2,500 feet in the Appalachian Mountains, soil and site requirements may be slightly relaxed.</p>
Shortleaf pine, pitch pine.	<ol style="list-style-type: none"> <li>1. All slopes and ridges; avoid poorly drained areas.</li> <li>2. Severe erosion allowable; top layer of dark-colored soil (topsoil) may be absent or mixed with lower layer of reddish soil.</li> <li>3. Topsoil, if present, may be plastic; under layer may be compact and cloddy and slick when plowed. No special soil conditions needed.</li> <li>4. Dense and overtopping vegetation causes heavy losses of planted trees. Broomsedge, light to moderate weed cover, or bare areas satisfactory.</li> </ol> <p>Do not plant shortleaf pine on areas over about 2,500-foot elevation. Substitute pitch pine or Virginia pine. On pure limestone areas it is preferable to substitute redcedar for shortleaf pine.</p>
Virginia pine, redcedar.	<ol style="list-style-type: none"> <li>1. All slopes and ridges. Avoid poorly drained areas.</li> <li>2. Severe erosion allowable; top layer of dark-colored soil may be absent.</li> </ol>



## SOUTHERN APPALACHIAN REGION—Continued

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Virginia pine, redcedar— Continued	<ol style="list-style-type: none"> <li>3. Dry sites, often with thin soil layer on bedrock with numerous rock outcrops; soil may be compact and cloddy. Plant redcedar on limestone areas and Virginia pine on shale areas.</li> <li>4. Vegetation usually sparse on these areas; dense vegetation harmful to success.</li> </ol> <p>If planted on better sites, especially limestone areas, redcedar may return equal or greater value than other species. In general, do not plant redcedar in the Appalachian Mountain region, except on limestone soils. Virginia pine is suitable for gully control. Do not plant redcedar within about 1 mile of valuable apple orchards.</p>

## VIRGINIA-CAROLINA PIEDMONT REGION

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Yellow-poplar, black walnut, black locust.	<ol style="list-style-type: none"> <li>1. Extreme lower slopes, coves, and well-drained bottoms.</li> <li>2. No apparent erosion; top layer of dark-colored soil (topsoil) 10 inches or more deep.</li> <li>3. Topsoil and at least 16 inches of soil layer beneath loose and friable, or mellow when worked; does not become hard and cloddy; drainage good.</li> <li>4. Moderate cover desirable; heavy cover of briars and rank weeds, or scattered low brush not harmful to yellow-poplar. In the Piedmont, black locust may be planted for erosion control in deep gully bottoms and around check dams where there is plentiful moisture and an accumulation of soil and debris. Pine is usually more successful, even for erosion control. Locust can be grown on suitable sites to a limited extent for posts. It does not grow well on very acid soils.</li> </ol> <p>Only very small areas of the Piedmont are suitable for these species. <i>They will not grow on abandoned old-field upland sites.</i></p>
Loblolly pine, shortleaf pine, redcedar.	<ol style="list-style-type: none"> <li>1. All slopes, ridges, and upland areas except obviously poorly drained spots.</li> <li>2. All erosion conditions except where only subsoil remains; top layer of dark-colored soil (topsoil) desirable for good growth, but not essential for success.</li> <li>3. Soil may be compact, and cloddy when worked, but lighter soils are preferable. No special soil conditions needed but better growth is obtained on lighter and deeper soils.</li> <li>4. Light to moderate cover of broomsedge or weeds beneficial; dense, overtopping briars or brush should be avoided.</li> </ol> <p>Practically all planting for forest products should be confined to these three species. Shortleaf pine and redcedar can be planted anywhere in the Piedmont. Loblolly pine should be mostly confined to its natural range, generally the lower half of the Piedmont region. Redcedar should not be planted within about 1 mile of valuable apple orchards.</p>

## VIRGINIA-CAROLINA PIEDMONT REGION—Continued

[Species recommended for planting, and their requirements]

Species to be planted	Soil and site characteristics needed for planting success
Virginia pine-----	<ol style="list-style-type: none"> <li>1. All slopes, ridges, and upland areas except obviously poorly drained spots.</li> <li>2. All erosion conditions including the most severe cases; presence of topsoil favorable but not necessary for success.</li> <li>3. No special soil conditions.</li> <li>4. Light to moderate cover of broomsedge or weeds beneficial but bare areas suitable.</li> </ol> <p>This species should be used chiefly for healing eroded, bare areas. If grown in dense stands on such areas it will produce pulpwood or tobacco wood.</p>

## EXPLANATION OF PLANTING GUIDES

In the planting guides, species with similar soil and site requirements are grouped together. Plant the species recommended for your region on areas as nearly as possible like those described for the species in the planting guide for your region.

Drainage refers to downward movement of water in the soil. Poorly drained areas are shown by mottled or blue to gray subsoils. Such areas are very rare in the Piedmont, and Appalachian Valley or Mountain regions. They are more abundant in the Central States, covering at least one-third of the planting areas. They are poor planting sites.

The nature of the top layer of soil is very important for planting success. The loose, crumbly, friable soils are generally favorable and for hardwood success they are necessary. The dense, compact soils which become cloddy and are slick when plowed, are generally unfavorable. The pines and redcedar, however, will succeed on this type of soil (figs. 5, 6, 7, 8).

Most planting will be done on rather open land but some sites will have considerable brush and young trees, although not enough desirable young trees to make a good stand. Such areas should be planted with the appropriate species, depending on the site. Stands of small, short-lived species such as sassafras, persimmon, and sourwood, can be interplanted (trees planted in openings) with yellow-poplar, white ash, black locust, black walnut, or eastern white pine; and the less dense stands on poorer sites with shortleaf, loblolly, or Virginia pine. Shortleaf, loblolly, pitch, and red pines, and redcedar should be used only where the planting spot receives nearly full sunlight.

Understocked stands of larger, longer lived species such as shortleaf pine or oak can be improved (reinforced) by planting in openings large enough to prevent overtopping by larger trees. Some of the planted trees may soon need to be freed from overshadowing or overcrowding (released). Improvement cuttings over the next few years will remove some of the larger trees and release the young ones. Unless the necessary release work can be done, it is not worth while making the plantings. (See figs. 9 and 10.)

A fairly good measure of land or site quality is the rapidity with which abandoned fields pass from the early weed stage of vegetation



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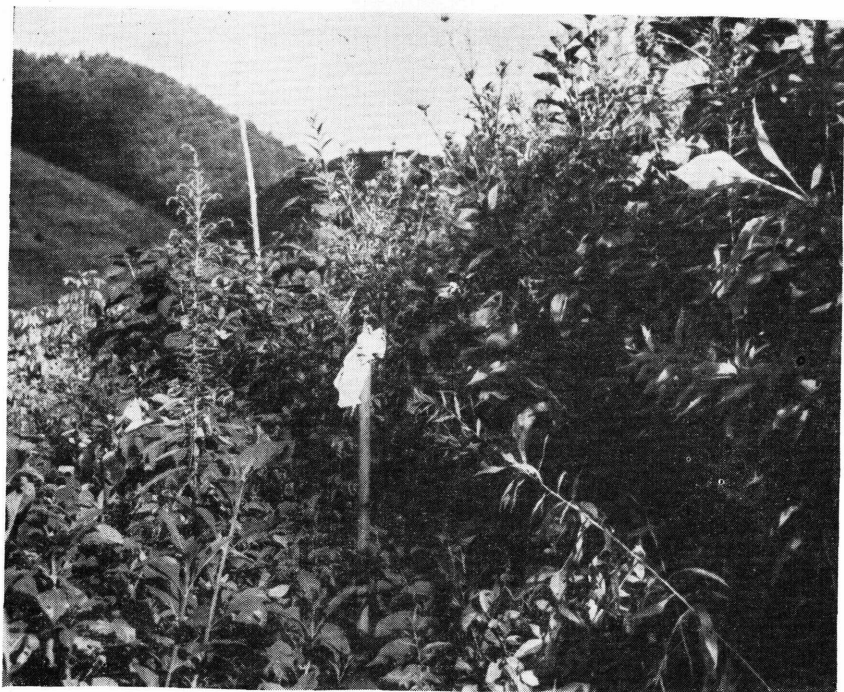
FIGURE 7.—A mixture of shortleaf pine and yellow-poplar 7 years after planting. The land has thin topsoil and a dense, compact subsoil. Yellow-poplar is not doing well on this site and will not make up an important part of the final stand.



F433362

FIGURE 8.—Shortleaf pine and black locust 7 years after planting. This is a site with a loose, mellow subsoil and the locust is outgrowing the pine. Later on the pine will catch up, and in the meantime the locust will produce fence posts. On good sites, such as this, it is better to mix locust with other hardwoods.





F406794

FIGURE 9.—Ground cover too dense for planting any kind of pine or redcedar. The pole is about 5 feet high. Such sites may usually be planted to yellow-poplar or white ash.



F406786

FIGURE 10.—Brush not too dense for planting eastern white pine and shortleaf pine; beneficial for yellow-poplar or white ash.



to a generous cover of briars or hardwood brush. The best sites usually develop blackberry briars or hardwood brush almost immediately. The medium to poor sites gradually pass into broomsedge and later into briars or brush. Freshly abandoned fields close to seed-producing pine stands usually are soon covered with young pine trees and do not need planting.

Some of the species in the planting guides can well be planted as mixtures (figs. 11 and 12). Mixtures are more natural, usually make better growth, and have less chance for complete failure. The best type of mixture is a checkerboard pattern with 9, 16, or 25 trees planted in a square (fig. 13). Alternating bands of 3 to 5 rows may be used instead of the checkerboard plan of planting. The following mixtures should prove successful on the sites indicated:

On yellow-poplar sites. (See planting guides pp. 12-17.)

- Yellow-poplar and black walnut
- Yellow-poplar and white ash
- Yellow-poplar and eastern white pine
- Yellow-poplar and shortleaf pine
- Yellow-poplar and black locust
- Black locust and black walnut
- White ash and black walnut
- Red oak and black walnut

On white pine sites. (See planting guides.)

- Eastern white pine and shortleaf pine
- Eastern white pine and yellow-poplar



F433378

FIGURE 11.—Successful 7-year-old checkerboard mixed plantation of yellow-poplar and shortleaf pine, on site suitable for yellow-poplar.

Both species in mixtures should have about the same growth rate on the site planted.

In certain parts of the Piedmont some shortleaf pine trees of pole size and larger die from what is known as little leaf disease. Until more is known about the incidence of little leaf on planted shortleaf pine, this species should not be planted in sections of the Piedmont where little leaf is severe.



F438567

FIGURE 12.—Successful 7-year-old checkerboard mixed plantation of yellow-poplar and eastern white pine, on site suitable for yellow-poplar. The yellow-poplar is outgrowing the pine but both will form a part of the final stand.

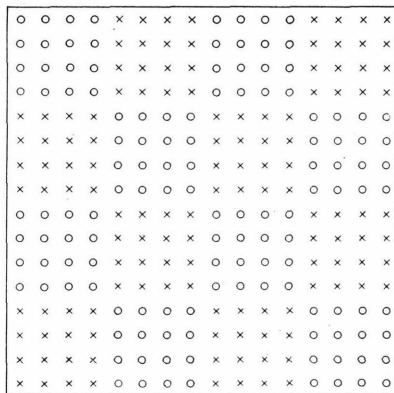


FIGURE 13.—Checkerboard pattern for mixing two species. Nine or twenty-five trees in a square may also be used.

## TREES OF DISTANT ORIGIN

As far as possible, trees planted on your farm should be produced from seed collected in the same general geographic region in which you live. The seed source ought not be over about 100 miles from the planting site and not over 1,000 feet different in elevation. It is suggested that you inquire as to the seed source of the trees furnished. It may not always be possible to obtain planting stock or seed produced in or near your locality.

Ordinarily, species of forest trees not native to your general locality should not be planted. It is usually wasteful and unwise to plant European species or far western species in the East. They are not adapted to the climate when brought so far from their native home. For the same reason, species should not be planted out of their natural range. A few exceptions to this general rule exist, however, such as Norway spruce, brought from Europe but successful in parts of the Central States region.

## HOW TO ESTABLISH TREE PLANTATIONS

The purpose of this section is to describe briefly how crops of trees may be started. Starting this crop is not as difficult as planting a crop of corn or tobacco, but the average farmer is not familiar with the methods. The "know-how" of any job makes the difference between success and failure.

## WHERE TO GET PLANTING STOCK OR SEED

The best place to obtain planting stock is a nursery. It may be possible for you to gather your own tree seed for seeding, or you might raise the seedlings in garden beds for planting. Wild seedlings may be taken from areas where there are too many and transplanted to places needing trees. The wildings usually have a more widespread root system than nursery seedlings and therefore are harder to transplant, and give lower survival. If they have been much shaded they are likely to be sun-scalded when set out in the open. There also may be doubt as to the species of the wildings. With good seedlings offered at very reasonable prices, most farmers will prefer to buy their planting stock.

All the States in the three regions considered in this bulletin have State nurseries with planting stock for sale to farmers approximately at cost, usually about \$2 to \$5 per thousand seedlings. Norway spruce, eastern white pine, and red pine may be somewhat higher. These State nurseries receive Federal money so they can furnish trees at low prices to farmers for forest and shelter-belt or windbreak plantings. The names and addresses of State agencies where planting stock can be obtained are given in the tabulation below. Commercial nurseries also sell planting stock and tree seed and a list of such nurseries will be supplied by the Division of Information and Education, U. S. Forest Service, Washington 25, D. C., upon request.

*State Forestry Agencies Where Planting Stock May Usually Be Obtained*

<i>State</i>	<i>Name and address</i>
Georgia-----	Department of Forestry, 435 State Capitol, Atlanta 3
Illinois-----	Division of Forestry, 301½ E. Monroe St., Springfield
Indiana-----	Division of Forestry, Department of Conservation, Indianapolis 9
Iowa-----	Forestry Department, Iowa State College, Ames
Kentucky-----	Division of Forestry, Conservation Department, Frank- fort
Missouri-----	State Forester, Missouri Conservation Commission, Jefferson City
North Carolina-----	Division of Forestry, 204 State Education Bldg., Raleigh
Ohio-----	State Forester, State Department of Forestry, Ohio Agricultural Experiment Station, Wooster
South Carolina-----	State Forester, 506 State Office Building, Columbia
Tennessee-----	State Forester, 309 New State Office Building, Nash- ville 3
Virginia-----	State Forester, University Station, Charlottesville
West Virginia-----	State Forester, Conservation Commission, Charleston

Make your planting plans ahead so you will know how many trees you will need (see Spacing of Trees) and can place your orders about 6 months before planting time if possible. In some cases the county agent, a representative of the Tennessee Valley Authority, or local Soil Conservation Service agents will help farmers prepare their orders.

### AGE OF PLANTING STOCK

Ordinarily the farmer will plant whatever class (age) of stock is available at the State nursery. This is usually excellent planting stock and the nurseries will advise what age class is available. In general, the tops of good plantable conifer seedlings are 6 to 10 inches long, those of hardwood seedlings 8 to 14 inches long, and the roots are as long as or longer than the tops. Larger trees require more work in planting, such as digging large holes. Nursery-grown planting stock is usually better for planting than lifted wildings (for reasons mentioned above), but the latter may be used where nursery stock is not available or is too costly. Where rodents are scarce or can be controlled, some species such as oak and walnut are best established by seeding directly in the field rather than planting nursery stock.

### CARE OF PLANTING STOCK

The care of trees between the time they are received and the time they are planted is a rather simple matter but very important. Remember that trees with roots out of the ground die from drying out unless the roots are kept moist all the time.

If the trees are to be planted within 2 or 3 days and are in good condition, they may be left in the bundles as received until planted. The bundles should be thoroughly soaked with water and left in a cool, shady, and well-ventilated place. Before wetting, it is best to loosen the bundles somewhat.

If planting will not be finished for some time, the trees should be "heeled-in," that is, stored in a V-shaped trench or series of trenches in a well-drained, shady spot of ground (fig. 14). Trees



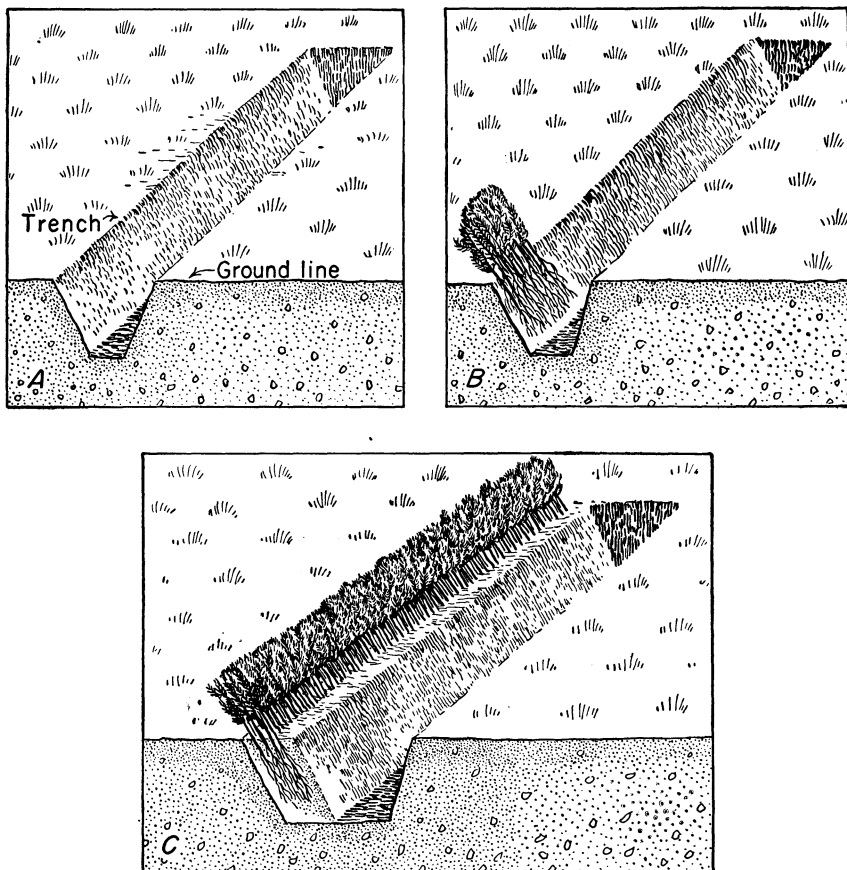


FIGURE 14.—Method of trenching and heeling-in nursery stock: A, Trench is dug deep enough to accommodate roots; B, layer of trees is laid against slanting wall; and C, soil is piled and packed against tree roots, leaving trench ready for another layer of trees to be heeled-in the same way.

come from the nursery tied in small bunches of 25 to 50 trees. It is best to untie these bunches and lay the trees in a layer 3 or 4 trees deep along the sloping side of the trench, then pack soil around the roots. They may then be lifted from the trench as required. The trench should be kept moist but not wet.

When ready to plant, trees should be placed in a bucket or other handy container and the roots kept continuously moist with moss, excelsior, soil, or other material. The roots should appear dark and moist, not whitish and dry. Soaking them after they have once become dry is of little use, especially with conifers (evergreens). They must not be allowed to become dry even for a short time.

### WHEN TO PLANT

Planting should be done sometime during the dormant season, that is, after the hardwood trees in your woods have lost their leaves in the fall and before new leaves start in the spring. Soil conditions

should be favorable. Obviously one could not plant in frozen or snow-covered ground. Also, planting should not be done when the ground is so wet as to be "soupy." The proper time for planting in the different States follows:

*States or portions of States*

*When to plant*

Ohio, Indiana, Illinois, Iowa, northern Missouri, Kentucky, West Virginia, and Virginia. Areas over approximately 2,500-foot elevation in the mountains of any of the three regions covered in this bulletin.

Spring—about March 15 to May 1. If necessary to distribute the work load, planting may be done from September 15 to November 15 in heavy cover where frost heaving will be least likely to occur. Spring planting gives best results.

Southern Missouri, Kentucky, West Virginia, and Virginia.

Spring—about February 15 to April 10. Fall—about November 1 to January 1. Spring planting gives best results. Fall-planted trees on heavy soils or in sparse, open cover are likely to frost-heave.

Tennessee, North Carolina, South Carolina, and northern Georgia.

December 1 to April 1, whenever ground is not frozen. February 1 to March 15 is best period.

## GROUND PREPARATION FOR PLANTING

For ordinary forest planting on old abandoned fields, pastures, or cut-over areas, very little ground preparation is needed. For the Central States region the exposure of bare soil by scalping or plowing furrows should be avoided except that small scalps 8 to 10 inches wide should be made in heavy sod, dense broomsedge, or dense, rank weeds. Large spots of bare ground tend to frost-heave the planted seedlings. Where small scalps or furrows are necessary because of heavy vegetation, planting should always be done in April, never in the fall.

In the southern Appalachian and Piedmont regions, scalps 10 to 14 inches in diameter or furrows should be used to remove heavy vegetative competition. The scalps can be made with the mattock or grub hoe, the same tool used for planting. On smooth sites without steep slopes (mostly in the Piedmont region) making shallow furrows is the cheapest way of removing vegetation. It is essential, however, that they be plowed on the contour so that they will not wash. Furrows should preferably be plowed 3 to 6 months before planting and the furrow slice thrown on the downhill side. The combination of furrows and the bar-slit planting method is perhaps the cheapest way of planting trees on sites where removal of competition from other plants is desirable.

## SPACING OF TREES

The cost of planting is almost directly related to the number of trees planted per acre; that is, the spacing or density of planting. For this reason, no more trees should be planted than are necessary to attain a well-stocked stand of quality trees. They should be close enough to force growth upward, to make tall trees with few branches, rather than widespreading trees.

Except for the special cases mentioned in table 2 and on pages 5, 34, and 35, spacing of less than 6 by 6 feet can seldom be justified. Usually 6- by 6-, 7- by 7-, or 8- by 8-foot spacings are satisfactory.

Remembering that costs of planting increase with density of planting, the following general rules may be helpful in determining spacing:

1. Species that develop branchiness in open stands (Virginia pine, pitch pine, eastern white pine, redcedar, most hardwoods) should be planted closer together than species which develop straight single stems rather free from branches (shortleaf pine, loblolly pine).

2. Rapidly growing species should have wider spacing than the slower growing ones.

3. On good sites, survival and growth are usually better and, for that reason, spacing may be wider than on poorer sites.

4. The closer spacings may be used where there is a strong demand for products removed in thinnings: Bean poles, tobacco wood, pulpwood, fence posts, etc.

5. Wider spacings should be used where there is already a partial cover of scattered hardwood brush on the area. These bushes will act as "trainers" and "pruners" to the planted trees and some of the stems will form a part of the stand, together with the planted trees.

6. When planting is done in furrows, costs will be reduced if spacing is wider between furrows than between the trees in the furrows.

The number of trees required per acre for different spacings is as follows:

4 by 4 feet-----	2, 722
5 by 5 feet-----	1, 742
5½ by 5½ feet-----	1, 440
6 by 6 feet-----	1, 210
6 by 8 feet-----	908
7 by 7 feet-----	889
8 by 8 feet-----	680

### SPEED OF PLANTING

It isn't the time it takes to plant trees that keeps people from planting. Getting started is often the hardest part of the job. Many people are surprised at the speed with which seedling trees can be planted even by inexperienced persons.

The number of trees a man can plant a day depends on the man, the kind of land, the species of trees (as it affects the root system), and the planting method used. The method of planting depends on the root system and the kind of planting site. On rough, rocky land the planter will have to dig a hole, insert the roots, and pack the soil around the roots with his hands. On smoother land, taprooted seedlings such as shortleaf pine can be planted in a slit in the ground made with a mattock or a planting bar. Trees with branching, spreading root systems may need to be planted in a hole, even on smooth land. The average man can plant about the following number of trees in an 8-hour day:

Rough, rocky land, trees planted in a hole-----	300
Smooth land, trees planted in a hole because of spreading roots-----	400
Smooth land, trees planted in a slit-----	600
Smooth land, trees planted in a slit in bottom of flat furrow--	800

Knowing the number of trees you intend to plant per acre and the size of the area, it is easy to figure the approximate number of man-days required for the planting job.

## METHODS OF PLANTING

After a young tree is planted it should :

1. Be at correct depth, about  $\frac{1}{4}$  inch deeper (*never higher*) than in the nursery. It is easy to see the old ground line on the tree.

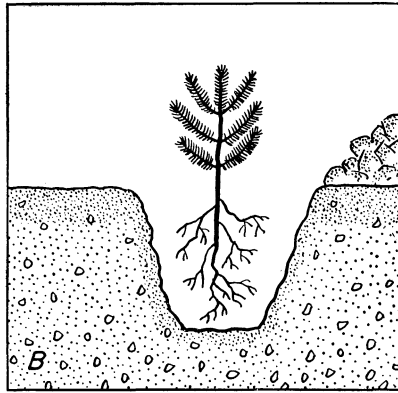
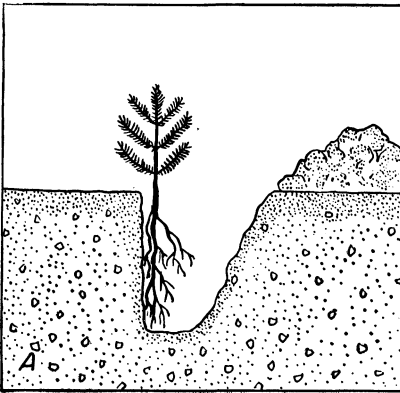
2. Have the main roots nearly straight, not doubled, or sharply bent. This is very important.

3. Have the soil firm around the roots, so that the tree cannot be easily pulled up.

4. Have an upright position and be nearly even with the general ground level, not sunk in a hole or raised on a mound.

There are two main methods of planting, either of which can accomplish the above aims, under the proper conditions. One is the hole method (fig. 15) and the other is the slit method (figs. 16 and 17). Table 4 tells which tool should be used with each method, type of land, and species.

## RIGHT



## WRONG

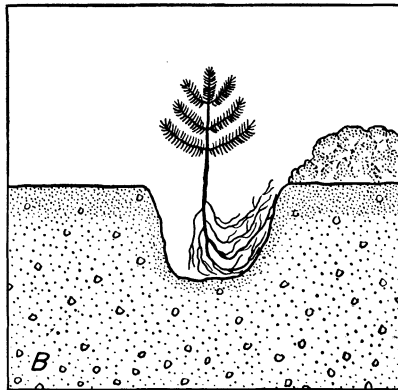
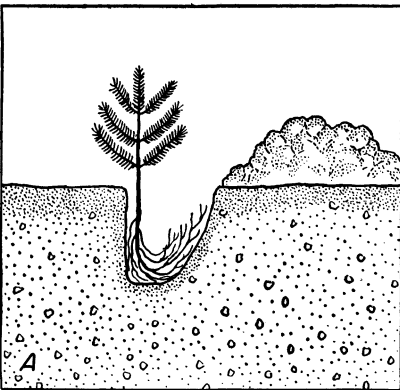


FIGURE 15.—Right and wrong methods of hole planting: A, Side hole method; and B, center-hole method.

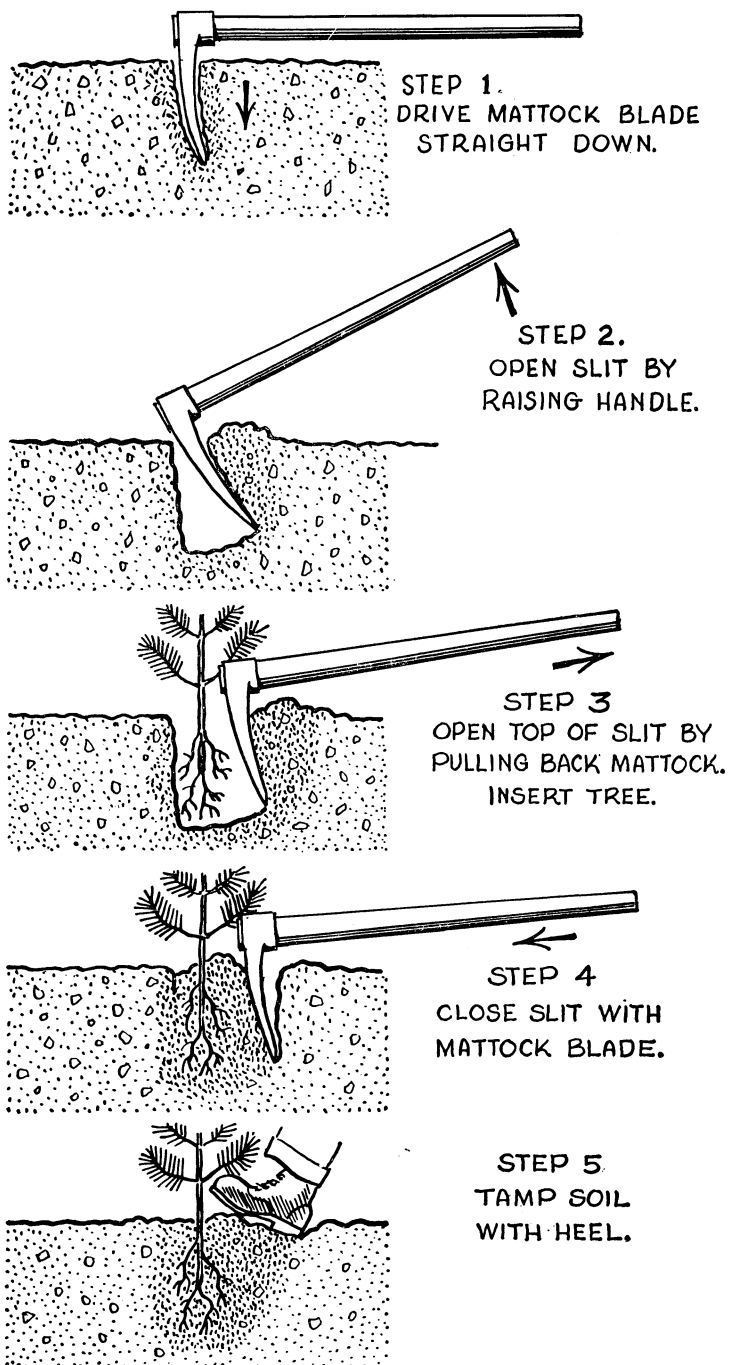


FIGURE 16.—Mattock-slit method of planting.

TABLE 4.—*Planting methods, and tools for different sites and species*

Method	Type of ground and cover	Tools suitable	Species
Hole, side or center	Rough, rocky land	{ Mattock Grub hoe Hazel hoe	All species.
	Smooth land	{ Mattock Grub hoe	
	Sparse cover	{ Spade Shovel	White pine, Norway spruce, red pine. <sup>2</sup>
	No scalps <sup>1</sup> necessary.	{ Mattock Grub hoe Hazel hoe	
	Smooth land		
	Dense sod or broom- sedge.		
Slit	Scalps necessary		
	Smooth land	{ Mattock Grub hoe Spade Planting bar	Red oak, yellow-poplar, sycamore, cotton- wood, black locust, white ash, loblolly pine, shortleaf pine, pitch pine, jack pine, Virginia pine, red- cedar. <sup>3</sup>
	Sparse cover		
	No scalps necessary		
	Smooth land	{ Mattock Grub hoe	
	Dense sod or broom- sedge.	{ Can use planting bar in furrows or previously pre- pared scalps.	
	Scalps or furrow necessary.		

<sup>1</sup> Scalps are small areas from which the vegetation has been removed, leaving the soil bare for planting.

<sup>2</sup> All species may be planted by this method, although it is more costly. It will result in an especially good planting job; on very heavy soils it is the preferred method.

<sup>3</sup> All species (except white pine, Norway spruce, and red pine) may be planted by the slit method, but it is especially suitable for species that usually have one long main root. Seedlings over 2 years old and transplant stock (transplanted once or more than once at the nursery) are not adapted to this method because of their widespread roots. This is the cheapest method on smooth land.

The side-hole method (fig. 15) consists of digging a hole deep enough to hold the roots of the tree. One side of the hole is left vertical and the tree is held against this side about  $\frac{1}{4}$  to  $\frac{1}{2}$  inch deeper than it grew in the nursery. Some moist, loose surface soil is then packed around the lower roots. The hole is then filled level and pressed with the foot. The chief precaution is to make sure that the hole is *deep enough so that the roots will not be doubled or bent*. The center hole method is similar except that the tree is placed in the center of the hole and soil packed around the roots (fig. 15).

For the hole method use a mattock, or long-bladed grub hoe, or hazel hoe. A shovel or spade may also be used. This method is especially adapted to rough, rocky land and to trees with spreading root systems.

The slit method (fig. 16) consists essentially of making a slit in the ground, inserting the tree roots and closing the slit both top and bottom. It may be done with a mattock, grub hoe, spade, or planting bar. It is much more rapid than the hole method and is especially adapted to smooth land with light to medium soils and for trees with one long main root (table 4). One very important precaution is to make sure the slit is deep enough for the roots.

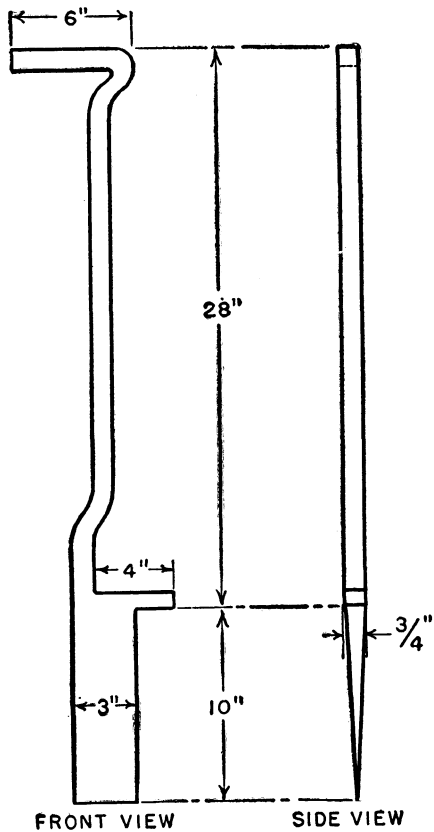


FIGURE 17.—Planting bar for bar-slit method.

The best tool for slit planting is a grub hoe or a planting bar with a blade 8 to 10 inches long. The blade should be at least as long as the roots of the trees being planted. If it is not, get a longer bladed tool, or prune the roots (but leave at least two-thirds the original length), or plant by the hole method. Do not double up the roots. If properly done, the slit method will give as good results for taprooted species on the light and medium soils as the hole method. It will be much cheaper because planting goes much faster.

The steps in planting by the grub hoe slit method (fig. 16) are as follows:

1. Sink the blade straight down into the ground so as to make a vertical slit with a depth equal to the root length.

2. Pry up on the end of the handle and pull back so as to open the slit slightly.

3. Insert the tree roots behind the blade to the proper depth and remove the blade.

4. Partially close the slit with the blade of the grub hoe while still kneeling. Especially in tight soils, be careful that no air pocket is left at the bottom.

5. Completely close the slit and pack soil around roots by stamping with the heel.

The planting bar is even faster than the grub hoe and is used where scalping (removal of grass or other plant cover) is unnecessary or sod is removed by plowing furrows. The planting bar is shown in figure 17. This tool may be purchased or made in the farm shop. The State forester or extension forester can supply names of manufacturers, and directions for use of the tool. It was developed for use in planting large acreages, and the farmer who plans to plant more than about 20 acres may save money by using it.

A special seedling lifter and transplanter which is convenient in using wild seedlings for small-scale farm planting is also made. Several types of tree-planting machines have been developed. They are useful chiefly on smooth, fairly level land. Anyone interested should consult the State or extension forester.

### REINFORCEMENT PLANTING

As already mentioned in the explanation of the planting guides, stands of poor, undesirable trees, or understocked stands may be reinforced or "sweetened" by planting young trees in the openings (interplanting) or underneath (underplanting) the existing stand. In stands of small, short-lived species such as sassafras, persimmon, and sumac, planting of species like yellow-poplar and eastern white pine is usually successful. However, in all reinforcement planting, *species should be selected by use of the planting guides*, just as for open fields. The voluntary growth on the ground will act as "trainers" for the planted trees and, if not too dense, the cover will be beneficial.

Although low, thin-crowned cover such as sassafras can be underplanted, planting on areas with dense brush or scattered young growth of long-lived trees should be confined to openings where direct sunlight reaches the ground. If the diameter of the opening is about twice the height of the surrounding trees, it may be planted, usually without any future cutting to free (release) the small planted trees.

Underplanting cull stands of slow-growing, low-grade oaks, particularly in the Ozarks and the Piedmont, is good practice. Short-leaf pine or loblolly pine, depending upon the locality, may be used to convert such stands to a mixed oak-pine forest. Within their natural range, eastern white pine or yellow-poplar can be used in the same way to improve the quality of woodlands. This kind of planting must be followed by release cutting, or girdling of over-shading trees in about 2 years. The release may well be a harvest cutting for fuel wood, ties, mine props or pulpwood. Do not underplant unless release is to be made. It will be a waste of time and money.

Reinforcement planting is usually worth while under the following conditions:

1. If the existing stand is composed of inferior or otherwise undesirable species of trees.
2. If the existing stand is understocked and the trees are too young to produce seed.
3. If it is desired to speed up the attainment of a fully stocked stand.
4. If conversion of the stand to a new species is desired, especially if the planting can be done just after a heavy or clear cutting.



Reinforcement planting, because of the greatly reduced number of trees planted per acre, is usually much cheaper (per acre) than open field planting. This holds true even where release cutting is necessary, if the products removed will pay for the cost of cutting.

### **DIRECT SEEDING IN THE FIELD**

In the Central States region only black walnut, eastern red oak, and shortleaf pine should be considered for direct seeding; in the southern Appalachian region only black walnut and shortleaf pine; in the Piedmont region, only loblolly pine, shortleaf pine, and black walnut. In all cases, seeding should be done only on sites as given in the planting guides.

The advantages of direct seeding are: (1) It may be much cheaper; (2) the farmer can collect his own seed, thus saving money and making sure that his trees are from local stock; (3) seeding can be done even if planting stock is unobtainable; (4) as seeding may be done in the fall, while planting is best done in the spring, the work load can be better distributed; and (5) the more natural root systems of seed plantings usually insure better trees.

Direct seeding, especially for pine, has one big disadvantage. In a bad year it may be a nearly complete failure. Rodents and drought are the greatest obstacles to success with direct seeding. It usually is useless to direct seed any of the above species in heavy broomsedge, because such sites are almost always infested with mice, which eat the seeds or seedlings. In general, pine seeding should not be done in any heavy vegetation.

### **Oak and Walnut Seeding**

The essential steps in establishing oak and walnut by direct seeding are as follows:

1. Collect seed by gathering sound acorns or walnuts from the ground underneath trees. Bad acorns may be separated from good ones by dumping them in a tub of water. The sound acorns sink and the bad ones float. Walnuts are usually sound and it is not necessary to remove the outer green pulp.

2. Usually it is best to seed in the fall any time after the seeds are collected. If early spring seeding is done, the seeds will need to be mixed with moist sand, peat, or a light loamy soil and left outdoors or in cold storage for the winter. Acorns should not be allowed to dry out before planting. Dry seeds, either walnut or oak, planted in the spring, will have delayed and low germination.

3. Prepare a 10- to 12-inch spot with a grub or hazel hoe by removing the vegetation and chopping the soil slightly.

4. Make holes with the fingers or hoe and insert two acorns or walnuts in a spot, several inches apart. Cover to a depth about equal to the width of the seed. A light mulch over the spot is beneficial but not necessary.

### **Pine Seeding**

On areas with a light cover of grass or other growth a small spot is made with a five-tined hand weeding tool or a light hazel or grub hoe. First remove the litter, then loosen up a small circular spot of bare

soil about 4 to 6 inches across. Distribute about 10 to 15 good seeds in the spot, cover with  $\frac{1}{8}$  inch of soil, and firm the soil with the hand. It is important not to cover the seed too deep, and seeding in a shallow trench (drill) will allow better judgment of depth. A drill across the prepared spot can be easily made with the finger or a short stick. On areas eroded bare a light mulch of litter not over  $\frac{1}{4}$  inch thick should be placed on each spot. In this case the seed would not be covered with soil.

By far the cheapest method of seeding pine on relatively smooth areas is by the use of a plow and a man-operated push-type mechanical seeder. The steps in this method are as follows:

1. Plow very shallow, flat-bottomed furrows *on the contour*, about 8 feet apart, estimating the contour by eye. Throw the furrow slice down hill in all cases.

2. Furrows should be plowed in late August or September and seeding done from late November until about Christmas. Rodent and bird damage is less if furrows are plowed a month or more before seeding.

3. Set mechanical seeder to drop two or three seeds per linear foot. Seed the area by running the seeder in the furrows at an ordinary walking speed. Do not cover seed with soil as it will be covered during the winter by frost heaving and washing. The chief reason for using the seeder is to obtain even, accurate, and fast distribution of seed. Hand seeding is slow and wasteful.

4. Rake into the furrows a very light covering of mulch not over  $\frac{1}{8}$  inch thick. This is the most time-consuming and least necessary. Experience may prove that it can be omitted. No mulch is better than too much mulch.

## SPECIAL TYPES OF PLANTING

### CHRISTMAS TREES

Farmers living within trucking distance of good Christmas tree markets may find growing Christmas trees a profitable side line. In the Central States, Norway spruce is recommended for this purpose and in the southern Appalachian and Piedmont regions, redcedar is the most suitable species. Virginia pine may often be sold for Christmas trees where better trees are scarce. Farmers owning cleared land at an elevation greater than approximately 3,000 feet in the Appalachian Mountains may plant southern balsam fir (Fraser fir). This is one of the best Christmas trees. It is fast growing, very attractive, aromatic, and holds its needles for a long time after cutting. It will not grow well, however, in hot climates or on exposed southerly slopes.

Norway spruce and redcedar should be planted on sites at least as good as given in the planting charts. Virginia pine will thrive on the poorest sites. For fast tree production, better sites would be preferable for all species, and cultivation for the first few years would increase growth. On good average sites, Norway spruce and southern balsam fir will make a 6-foot tree 7 to 9 years after planting. Fir usually will grow somewhat faster than the spruce. Natural redcedar trees 6 feet tall at 7 years of age have been found on the Virginia Piedmont. On good cedar sites the first crop of 6-foot cedar trees may be

expected about 8 years after planting. Virginia pine will produce trees in 4 or 5 years.

Small Christmas trees, 3 or 4 feet high, are becoming popular. Where there is a market for trees of this size, plantings should be spaced 4 by 4 or 5 by 5 feet, and thinned as the trees become merchantable. If new trees are planted in the larger openings as harvesting proceeds, the plantation will produce year after year. The production of Christmas trees may be combined with pulpwood and timber production by using only early thinnings for Christmas trees.

Christmas tree production is a rather specialized line of forestry and will not be treated fully here. For further information, see your State or extension forester.

### WINDBREAKS

Some farmers who live in generally flat country, particularly in the western part of the Central States, may wish to make windbreak plantings around buildings and stockyards. No attempt will be made to give a full description here, but references are cited in the last section. A few helpful hints are given below.

1. Evergreens such as Norway spruce, red pine, redcedar, and arborvitae are the best windbreak species.

2. Windbreaks should be on the windward side, 75 to 100 feet from buildings or areas to be protected, and should extend 100 to 150 feet beyond them on either side.

3. Two or more rows of trees spaced 8 to 10 feet apart between rows and 6 to 8 feet apart in the rows make a good windbreak. Trees in the rows may be thinned if necessary. Cultivation the first few years is desirable.

4. The outside row on the windward side should be redcedar or arborvitae spaced 6 feet apart. These trees are dense and retain their limbs all the way to the ground. Redcedar should not be planted closer than about 1 mile from valuable apple orchards in order to prevent apple rust.

5. If quick shade is desired around buildings or lots, plant fast-growing hardwoods like cottonwood, Carolina poplar, soft maple, or Chinese elm. For permanent shade trees of desirable form, plant sugar maple, American elm, pin oak, white oak, or sweetgum.

### FENCE-POST PRODUCTION

The 2 species suitable for fence posts without preservative treatment are black locust and redcedar. Locust requires very good sites where it will make rapid growth. Redcedar will produce posts on poor or average sites. If locust is planted on deep, uneroded, mellow soils (see planting guides) it will produce posts in 8 to 10 years. In 12 to 14 years, 2 posts per tree can usually be obtained. On good land locust sprouts vigorously and a new crop of posts will be ready in about 8 years more.

Fence rows, fence corners, or other odd places around the farm where no cultivation occurs are good places to grow locust posts. One acre of locust on a very good locust site might well produce an where no cultivation occurs are good places to grow locust posts. be produced because the trees would die or be severely damaged by

the locust borer before they reached sufficient size. On any site some losses from locust borer can be expected but trees produced from seed of sound, native local stock and grown on good sites will have high resistance to damage by borers.

The use of phosphate fertilizer and cultivation for a year or two will speed growth, especially on sites not quite up to locust quality. Breaking the subsoil with a subsoil plow would also help, but should not be substituted entirely for desirable soil characteristics.

The poorest areas on the farm, especially limestone outcrop land, can be used for cedar post production. In the Virginia Piedmont cedar will produce one post per tree in 20 to 25 years. A thinning at 35 to 40 years will produce an average of 1½ posts per tree. A few scattered cedars on good pasture land will make posts and not decrease grazing.

A good way to handle redcedar is about as follows: (1) Plant about 5 by 5 feet apart; (2) at 8 years take out about 150 to 200 Christmas trees per acre; (3) at 20 to 25 years, thin the stand for posts, taking out 150 to 300 trees per acre, depending on its density; (4) at 35 to 40 years, make a second thinning for posts, leaving the remainder of the trees to develop into small sawlogs. Ordinarily the second thinning would remove 150 to 300 trees, leaving about 350 for a sawlog and post harvest at 50 years.

### EROSION CONTROL

The planting guides show what species will succeed on eroded land. Areas with the topsoil eroded away should be planted to Virginia pine, shortleaf pine, or a mixture of these species. Within its range on the Piedmont, loblolly pine may also be used. On the worst areas spacing should be 5 by 5 feet. Pitch pine is satisfactory on areas over 2,500 feet in elevation.

Locust may be used to a limited degree in the bottoms of deep gullies or where there is an accumulation of some loose soil, and good moisture conditions. A good system is to plant pines on sides of gullies and at margins of gully bottoms, and locust in the deep gully bottoms. Grass and other herbaceous plants will come in on moist sections not covered by needle litter. Locust spaced about 10 by 10 feet may also be used to advantage on good limestone pasture soils which have become run down by overgrazing and erosion. The locust will help restore the pasture if *grazing is completely eliminated* until the main branches are above the reach of stock.

If eroded areas can be restored to good agricultural land, the farmer should consult his county agent or Soil Conservation Service technician in the soil conservation district, as to the methods needed.

### HOW TO CARE FOR YOUR TREE CROP

One of the big advantages of growing trees is the small amount of time and labor needed to care for them. They almost take care of themselves. What little care they do require can be given during the winter or other slack season on the farm. The same thing applies to harvesting of forest products. The work can be done at odd times or postponed for improved prices.

## PROTECTION

Forest plantations should be protected from fire and grazing. Tree diseases and insects will not ordinarily do much damage and the best general remedy is planting on the correct sites. Weak, slow-growing trees are always much more subject to disease and insects than vigorous ones. White pine can be protected from the blister rust by pulling up all the gooseberry and currant bushes within 1,000 feet of the trees. The European black currant must be eradicated for a distance of 1 mile. If serious outbreaks of any disease or insects occur in your trees, consult your State forester or extension forester.

It is essential that the tree plantings be protected from fire. This can be done partly by careful handling, by yourself and neighbors, of brush fires, grass fires, smokes, and matches. If the planting is in a place exposed to fire, a strip 10 to 15 feet wide should be plowed around it and kept fresh by discing as necessary. To prevent erosion, avoid, if possible, having the bare fire lanes run up and down a slope.

It is necessary to protect forest plantations, especially hardwood plantations, from livestock. Pine plantations may be lightly grazed for a few years without too serious injury. Heavy grazing by cattle, horses, sheep, or hogs will ruin the trees by browsing, trampling, uprooting, and breaking the trees. Livestock should be restricted in pine plantations and kept out of hardwood plantations entirely. The fences should be maintained permanently, as heavily grazed woodlands deteriorate rapidly and are neither good pasture nor good forests.

## RELEASE CUTTINGS

Ordinarily trees planted on old fields will need very little, if any, release from overtopping growth. Trees planted in brushy fields may need release. A few simple rules regarding release are given as guides (fig. 18).

1. Need for release can be determined by inspection of the trees during the summer. If trees are growing well and look vigorous, they need not be released. Trees overtopped by dense shade of undesirable growth should be released. The cutting should allow full sunlight on the tree for at least half the day.

2. Brush and small voluntary trees mixed with the planted trees often act as "trainers" and their partial shade may be beneficial to hardwoods and white pine.

3. All rough, undesirable, or "wolf" trees (widespreading trees that rob others of sunlight, moisture, and space) should be cut or girdled. They occupy space that should be used by crop trees.

4. Voluntary growth of desirable species adapted to the site should not be cut even if it overtops a planted tree.

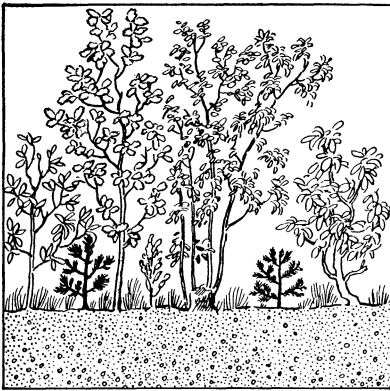
5. The best time to release is early summer, about June 15 to July 10. At this time there will be the least sprouting. It is also easier to tell which trees are so shaded that they need release.

## PRUNING

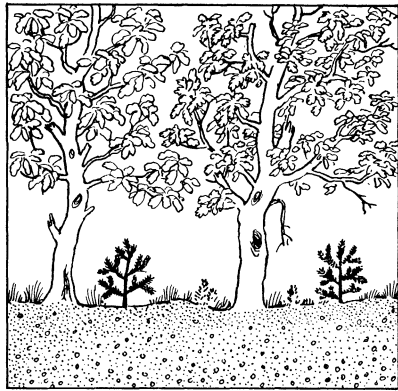
Pruning removes the lower live or dead branches along the trunk of a tree. It greatly increases the quality of the lumber (branches



RELEASE NEEDED

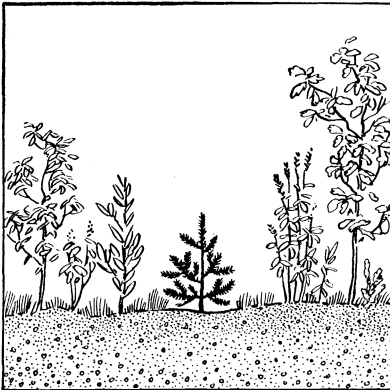


Brush 3 to 4 feet high suppressing pine or spruce 2 to 4 years after planting.

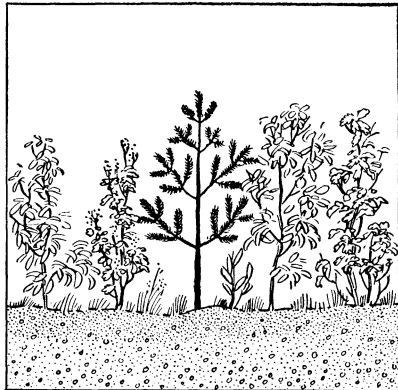


Rough, undesirable "wolf" trees suppressing 5-to-10-year old planted pine or spruce.

RELEASE NOT NEEDED



Planted pine or spruce in opening in low brush and weeds.



Planted pine or spruce emerging from low brush, weeds, or briars.

FIGURE 18.—Conditions under which release of planted trees is and is not needed.

make knots), decreases fire hazard, and makes it possible to move about freely within the planting without dodging limbs. Of the species recommended for planting, probably only eastern white pine, Virginia pine, and pitch pine need to be pruned. The branches should be cut flush with the trunk.

The first pruning should be done when the trees are not over 15 to 20 feet tall. The trunks should be cleared of branches to a height of 6 or 7 feet, but never over half the height of the tree. When the trees are 30 to 35 feet tall, about 250 of the best trees per acre should have the trunk pruned of all branches up to a height of 17 or 18 feet. These trees should be reserved for the final sawlog crop. Each will have one 16-foot clear butt log.

Pruning is best done with a curved pruning saw on a strong but light pole. An ax should never be used for pruning. Pruning may be done "anytime the saw is sharp," and a few odd hours now and then spent using the pruning saw will return profits, decrease fire hazard, greatly improve the appearance of your stand, and make future thinning operations easier.

## THINNING

Thinning consists in removing a certain portion of the trees in a young forest stand. It saves wood products that would otherwise die and be lost, and it increases the growth of the remaining trees. It is like thinning a row of beets. You can use the pulled beets for greens and you leave room for beet bottoms to grow. Usually the worth of the material harvested more than pays the cost of the labor.

If good survival is obtained in planting, all species recommended for planting will need thinning. The fast-growing pines and yellow-poplar may usually be thinned for small products like pulpwood, mine props, and fuel wood in 15 to 20 years. A second and third thinning can usually be made at about 10-year intervals. Each should yield a good profit. In thinnings the poorer trees should be removed, leaving the best trees to grow into sawlogs. Heavy thinnings in dense stands may result in much ice storm damage.

For slower growing species, the first thinning may need to be postponed, and longer intervals left between operations, but the principle is the same. Redcedar may be thinned for Christmas trees and both this species and black locust should be thinned for fence posts. If treated with a preservative, pine thinnings also make good fence posts. In the bright-leaf tobacco belt, thinnings make excellent tobacco wood.

A good general rule-of-thumb for thinning in stands up to 6 inches average diameter breast high (d. b. h.) is as follows: *The average distance in feet between trees after thinning should equal the average d. b. h. in inches plus 5.* For stands with an average d. b. h. of 6 inches or more the rule should read as follows: *The average distance in feet between trees after thinning should equal 1.75 times the average d. b. h. in inches.*

## FOREST CULTURE

Aside from release cutting, pruning and thinning, there are other practices essential to good woodland management. The forest manager must continually strive to improve his crop. Some trees are a poor risk because they are likely to die or be blown over. These should be removed while they are still valuable. Great, rough, spreading trees (wolf trees) usually occupy too much room for their worth. If usable they should be cut; if not, girdle them. The space can then be occupied by profitable trees. Trees that are crooked or otherwise inferior are not adding value from year to year as they should. Cut them for fuel wood. Trees of inferior species should be cut first so that the better species will tend to increase. All these are common-sense practices which a farmer can easily carry out. They are usually called improvement cuttings.

The removal of sawlogs, or perhaps pulpwood, is usually the goal of all forestry practice. Such a cutting, however, must provide for reproduction of the stand in order to avoid the necessity of expensive replanting. This is a subject by itself and no attempt will be made here to discuss it. The farmer wishing information should consult his farm forester, extension forester, or county agent. Other sources of information are given in the next section.

## OTHER SOURCES OF INFORMATION

Those desiring additional or more detailed information should write to their State forester or extension forester for available bulletins or pamphlets. The following publications of the U. S. Department of Agriculture on the planting and care of trees are available from the Office of Information, Department of Agriculture, Washington 25, D. C.:

- Little Leaf Disease of Pine. 1945. 15 pp. illus. Cir. 716.
- Managing the Small Forest. 1947. 61 pp. illus. Farmers' Bul. 1989.
- Planting Black Walnut. 1932. 8 pp. illus. Leaflet 84.
- Planting Southern Pines. 1938. 8 pp. illus. Leaflet 159.
- Protect Hardwood Stands From Grazing. 1941. 8 pp. illus. Leaflet 86.
- The Windbreak as a Farm Asset. 1944. 22 pp. illus. Farmers' Bul. 1405.
- Woodlands in the Farm Plan. 1943. 22 pp. illus. Farmers' Bul. 1940.

